

## KARYOTYPE ANALYSIS OF THE GENUS *EUCOMIS* (LILIACEAE)

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### ABSTRACT

Ten *Eucomis* spp. were investigated cytogenetically. Diploids ( $2n = 30 = 2x$ ) and tetraploids ( $2n = 60 = 4x$ ) occur in the genus and each karyotype consists of macro- and microchromosomes.

### UITTREKSEL

#### KARIOTIPE ANALISE VAN DIE GENUS *EUCOMIS* (LILIACEAE)

Uit 'n sitologiese ondersoek wat op tien *Eucomis* spesies gedoen is, is diploïede ( $2n = 30 = 2x$ ) en tetraploïede ( $2n = 60 = 4x$ ) gevind en elkeen se kariotipe bestaan uit makro- en mikrochromosome.

### 1. INTRODUCTION

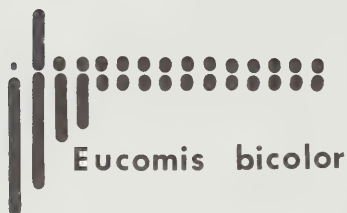
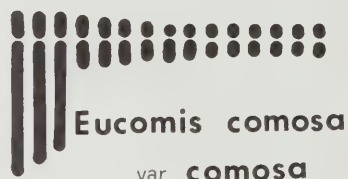
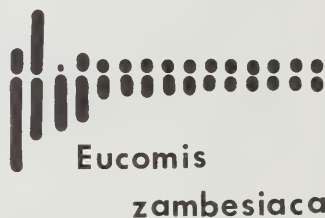
The genus *Eucomis* L'Hérit. or pineapple lilies are represented in Southern Africa by ten species, of which five are endemic to the Republic of South Africa.

Since Reyneke (1972) found difficulty in distinguishing morphologically between certain species and subspecies of the genus, chromosome counts were made. From these counts it became clear that karyotype studies would provide a considerable amount of additional information that could be used in an attempt to elucidate the phylogeny of the genus.

### 2. MATERIAL AND METHOD OF INVESTIGATION

Bulbs of different *Eucomis* plants were placed on moist vermiculite at the beginning of a growing season. Young roots which were approximately 10 mm long, were collected between 11h30 and 12h30 and treated in a 0.05 % colchicine solution for 1½ hours. This material was then fixed in Pienaar's fixative (Pienaar, 1955). Good results were also obtained with pre-fixation treatment of three hours in a saturated solution of paradichlorobenzene followed by fixation in either Pienaar's fixative or Carnoy's fixative (Haskell & Wells, 1968). After a fixation period of 24 hours at room temperature, the material was transferred to 70 % ethanol and stored at 0-5 °C.

Prior to staining with leucobasic fuchsin for 1-1½ hours (Haskell & Wells, 1968) the material was hydrolised for 12-14 minutes in 1M HCl at 60 °C. After

*Eucomis autumnalis* ssp. *clavata**Eucomis humilis**Eucomis bicolor**Eucomis comosa*var. *comosa**Eucomis regia**Eucomis**zambesiaca*

staining, the material was rinsed in tap water for 1–3 minutes, squashed between a microscope slide and a cover slip, dehydrated in an alcohol series and mounted in euparal.

Chromosome studies of *E. comosa*, *E. montana*, *E. schiffii* and *E. zambesiaca* were limited to one or two plants only due to the unavailability of more material while in all other species at least five specimens from different localities were studied.

### 3. RESULTS AND DISCUSSION

#### 3.1 Chromosome morphology

Macro- and microchromosomes (Fig. 1) were present in the karyotype of all *Eucomis* spp.

Due to variation in the microchromosome number of certain species (see Table 1) it was therefore decided to restrict the identification of a karyotype mainly to the number of macrochromosomes. In some species however, e.g. *E. humilis*, intermediate chromosome sizes occur preventing precise classification of chromosomes.

In all the *Eucomis* species examined the macrochromosomes are submetacentric or acrocentric and there is a marked difference in size of a given karyotype. According to the definition of Stebbins (1971) an asymmetric or advanced karyotype has acrocentric chromosomes and the largest and smallest chromosomes differ conspicuously. The karyotype of the genus *Eucomis* is therefore advanced as far as chromosome morphology is concerned.

The most advanced karyotype apparently is that of *E. comosa* var. *comosa* (Fig. 1) where six clearly distinguishable macrochromosomes and 24 microchromosomes are present. This distinction is not as conspicuous in *E. regia*.

*E. regia* and *E. schiffii*, which are morphologically very similar, can easily be distinguished cytologically since *E. regia* has 6 macro- and 24 microchromosomes while *E. schiffii*, like *E. zambesiaca*, has 8 macro- (4 long, 4 medium) and 22 microchromosomes.

*E. humilis* ( $2n = 60$ ) has the most primitive karyotype of the polyploid *Eucomis* species, and *E. regia* ( $2n = 30$ ) the most primitive of the diploid species because their chromosomes exhibit continuous variation from the macro to the micro form. The three remaining diploid species, viz. *E. vandermerwei*, *E. zambesiaca* (Fig. 1) and *E. schiffii*, each with 8 macro- (4 long, 4 medium) and 22 microchromosomes represent an intermediate group between the advanced *E. comosa* var. *comosa* and the primitive *E. regia*.

#### 3.2 Changes in ploidy

In the genus *Eucomis* diploids and tetraploids were found. The number of chromosomes in all the diploids is 30 ( $2n = 30 = 2x$ ) while polyploids have 60

TABLE 1.

Chromosome numbers and the number of macrochromosomes in different species, sub-species and varieties of the genus *Eucomis* L'Hérit.

| Species                                                                 | Localities                | No. of Macrochromosomes | Diploid number       | Author                                       |
|-------------------------------------------------------------------------|---------------------------|-------------------------|----------------------|----------------------------------------------|
| <i>E. autumnalis</i> (Mill.) Chitt.<br>subsp. <i>autumnalis</i>         | Hogsback                  | 8                       | 60                   | Koerperich (1930)<br>Riley (1962)<br>Reyneke |
| <i>E. autumnalis</i> subsp.<br><i>amaryllidifolia</i> (Bak.)<br>Reyneke | Fauresmith                | 8                       | 60                   | Reyneke                                      |
| <i>E. autumnalis</i><br>subsp. <i>clavata</i> (Bak.)<br>Reyneke         | Pretoria                  | 8                       | 30                   | De Wet (1957)                                |
|                                                                         |                           | 8                       | 60<br>60-64          | Riley (1962)<br>Reyneke                      |
| <i>E. bicolor</i> Bak.                                                  | Cathedral Peak            | 4                       | 30-32<br>(34?)<br>32 | Müller (1912)<br>Darlington (1926)           |
|                                                                         |                           | 8                       | 30                   | Matsuura & Sutô<br>(1935)                    |
|                                                                         |                           | 4                       | 30-32                | Reyneke                                      |
|                                                                         |                           |                         |                      |                                              |
| <i>E. comosa</i> (Houtt.) Wehrh.<br>var. <i>comosa</i>                  | Cultivated                | 6                       | 60                   | Matsuura & Sutô<br>(1935)                    |
|                                                                         |                           | 8                       | 60                   | Sâto (1941)                                  |
|                                                                         |                           | 6                       | 30                   | Reyneke                                      |
| <i>E. comosa</i> var. <i>striata</i><br>(Donn) Willd.                   | Ixopo                     | 10                      | 60                   | Reyneke                                      |
| <i>E. humilis</i> Bak.                                                  | Cathedral Peak            | 10                      | 60                   | Reyneke                                      |
| <i>E. montana</i> Compton                                               | Belfast                   | 8                       | 60                   | Reyneke                                      |
| <i>E. pallidiflora</i> Bak. var. <i>pallidiflora</i>                    | Port Shepstone            | 8                       | 60                   | Reyneke                                      |
| <i>E. pallidiflora</i> var. <i>polevansii</i> (N. E. Brown)<br>Reyneke  | Belfast                   |                         | 50                   | De Wet (1957)                                |
|                                                                         |                           | 8                       | 60-64                | Reyneke                                      |
| <i>E. regia</i> (L.) L'Hérit. subsp.<br><i>regia</i>                    | Napier                    | 6                       | 30                   | Reyneke                                      |
| <i>E. regia</i> subsp. <i>pillansii</i> (L.<br>Guthrie) Reyneke         | Kamieskroon               | 6                       | 30                   | Reyneke                                      |
| <i>E. schiffii</i> Reyneke                                              | Cathedral Peak            | 4                       | 30-32                | Reyneke                                      |
| <i>E. vandermerwei</i> Verdoorn                                         | Middelburg                | 4                       | 20                   | De Wet (1957)                                |
|                                                                         |                           | 4                       | 30                   | Reyneke                                      |
| <i>E. zambesiaca</i> Bak.                                               | Blouberg<br>(Pietersburg) | 4                       | 30-32                | Reyneke                                      |

chromosomes ( $2n = 60 = 4x$ ). Except for the results obtained by De Wet (1957) this corresponds with results of most previous authors (see Table 1) even in respect of the number of macrochromosomes. De Wet's results are dubious because he used microtome sections for counting chromosomes.

A chromosome count of a cultivated plant of *E. comosa* var. *comosa* from an unknown original locality gave  $2n = 30$ . This differs from published counts (Matsuura & Sutô, 1935; Sâto, 1941) but var. *striata* may possibly have been examined by these authors, accounting for this discrepancy.

Except for *E. humilis* which produces a relatively small number of seeds, all the *Eucomis* spp. are fully fertile. It is therefore probable that the fertile polyploids are allotetraploids and *E. humilis* is a autotetraploid or even more a segmental allotetraploid. In general the karyotypes are in agreement with these suggestions since none of the tetraploids have chromosomes that occur in sets of 4. At best the macrochromosomes could be grouped in pairs only. This would suggest a hybrid polyploid origin in which the hybridisation occurred between diploids with divergent karyotypes.

The popular conception that polyploids are larger plants than their diploid relatives holds true in the genus *Eucomis*. Eight of the fifteen *Eucomis* taxa are tetraploids and the plants of all these taxa are larger than the seven diploid taxa.

Another result of the duplication of chromosomes is the fact that the tetraploids were observed to grow more slowly than their diploid relatives resulting in a relatively late and lengthy flowering period.

#### 4. ACKNOWLEDGEMENTS

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